DOCUMENT RESUME

ED 276 566 SE 047 540

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TITLE The Preparation and Continuing Education of Mathematics Teachers in Alberta: A Status Survey and Needs Assessment. Final Report.
PUB DATE Dec 86
NOTE 34p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Educational Quality; Educational Research; Elementary Secondary Education; Foreign Countries; Higher Education; *Mathematics Education; *Mathematics Teachers; Needs Assessment; Preservice Teacher Education; *Professional Development; Surveys; *Teacher Education; *Teacher Qualifications
IDENTIFIERS *Alberta; *Mathematics Education Research

ABSTRACT

Concerns about the quality of education, teachers, the curriculum, instructional materials, and teachers' professional developments led to the commissioning of a survey of mathematics teachers in Alberta, Canada. Stratified random samples of 100 elementary schools and 100 secondary schools were drawn. In elementary schools all teachers were asked to respond; in secondary schools, all teachers teaching mathematics were asked to respond. Principals responded to a third questionnaire. Responses were received from 137 principals, 477 elementary teachers, and 241 secondary teachers. Recommended qualifications for teachers of mathematics were summarized using reports of professional organizations and the three universities with teacher education programs in the province. Only one university had a university level mathematics requirement for elementary teachers; all three had clearly defined majors and minors in mathematics for secondary teachers. Data on the following were then presented and discussed: school characteristics, teachers' personal characteristics; teachers' preservice education, teachers' in-service education, teachers' membership in professional organizations, teachers' opinions about support for mathematics teaching, and principals' and teachers' identification of needs. The concluding comment noted that broad academic backgrounds, a full range of supporting materials and services, and wide involvement in professional organizations have not yet been achieved. Appendices contain the questionnaire forms. (MNS)

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The Preparation and Continuing Education of Mathematics Teachers in Alberta: A Status Survey and Needs Assessment

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Prepared for

The Mathematics Council of the Alberta Teachers' Association

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by

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and

M. Louise Frame

Final Report: September, 1986
Second Printing: December, 1986

SE 047 540

ACKNOWLEDGEMENTS

The completion of this survey and the preparation of this report would not have been possible without the cooperation and help of a number of persons and organizations. The authors offer their sincere thanks to

The members of the MCATA Executive (1984-85) who initiated the project and supported it fully as it got underway,

Alberta Education which provided information on schools operating in Alberta from which the survey samples were drawn,

The nearly 150 principals and more than 700 teachers who responded to the questionaires,

The school systems and administrators who facilitated the distribution and return of survey materials through personal contact and via school mail,

Dr. K. G. Dueck and Dr. D. A. Roberts, University of Calgary department heads, who provided encouragement for the project and made available facilities for printing, mailing, and word processing.

-- T. L. Schroeder & M. L. Frame

CALL FOR ACTION

This Final Report has been distributed to all members of the Mathematics Council of the Alberta Teachers' Association, to the principals and teachers who took part in the survey, and to interested individuals in schools, school district offices, universities, and Alberta Education. Now the Mathematics Council must consider what actions need to be taken to address the issues raised in the report.

In this process all interested parties are being invited to give their reactions. Early in 1987 the Mathematics Council plans to publish a collection of papers recommending specific actions to be taken by MCATA and others concerned with mathematics education in Alberta. Colleagues who wish to participate in this activity are asked to send their contributions before March 15, 1987 to:

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THE PREPARATION AND CONTINUING EDUCATION OF MATHEMATICS TEACHERS IN ALBERTA: A STATUS SURVEY AND NEEDS ASSESSMENT

Prepared for the Mathematics Council of the Alberta Teachers' Association

By Thomas L. Schroeder & M. Louise Frame

INTRODUCTION

Members of the general public always seem to have questions about the quality of the education that is being provided to their young people. For example

Does the educational system set high standards? Does the curriculum meet the needs of all students and the expectations of society at large?

Is there a shortage of qualified teachers? Are the present teachers competent to teach the subjects and grades to which they are assigned? Do teachers keep up-to-date through continuing education?

Are the textbooks of high quality? Are they relevant to the curriculum and the needs of the students? Are other instructional materials and equipment such as computers available in the schools?

Are teachers adequately supported with professional books and journals? with referral services? with opportunities for professional development?

In recent years questions such as these have been prominent in the mass media, but the answers that have been offered have sometimes not indicated a high degree of confidence and satisfaction. Like many other professional organizations, the Mathematics Council of the Alberta Teachers Association (MCATA) is concerned about these issues, especially as they relate to mathematics teaching in Alberta. In order to make an informed and positive contribution to the continuing discussion, MCATA commissioned this study, titled "The Preparation and Continuing Education of Mathematics Teachers in Alberta: A Status Survey and Needs Assessment."

BACKGROUND

Numerous commission reports, task forces, and magazine articles have addressed the quality of public education and identified needs for change in many areas, including mathematics education. One of the best known of the recent commission reports on education is the one by the United States National Commission on Excellence in Education entitled "A Nation At Risk." This report made headlines in 1983 with its declaration that "If an unfriendly foreign power had attempted to impose on America the mediocre educational

performance that exists today, we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves."

The "Nation at Risk" report deals with U. S. secondary and post-secondary education in all subjects, but its findings with respect to mathematics, physics, and foreign languages are particularly alarming. It found evidence of a lack of committment to excellence in the fact that while Intermediate Algebra was offered in all American high schools it was completed by only 31% of recent graduates, and the fact that while calculus is offered in high schools enrolling about 50% of all students only about 6% of all students complete it. It also noted that in 1980, 35 of the 50 States required only one year of mathematics for a high school diploma.

The Commission also considered the teaching profession and concluded that "half of the newly employed mathematics, science, and English teachers are not qualified to teach these subjects." It declared there to be a "severe" shortage of teachers in mathematics and science and noted that 43 of 45 States surveyed in 1981 reported shortages of teachers of mathematics.

A second major report is that of the Conference Board of the Mathematical Sciences, titled "New Goals for Mathematical Sciences Education," issued in 1984. This report called for a renewal of mathematics teachers' content knowledge, teaching skills, and enthusiasm for their work. This need was said to exist at all levels, elementary, secondary, and post-secondary. It was noted that mathematics at the elementary level is commonly taught by generalists who have responsibility for all subjects, too often without the leadership and support of mathematics resource specialists; the training of additional specialists or "partial specialists" to meet this need was recommended. At the secondary level it was stated that teachers underqualified to teach the current traditional curriculum need programs which provide the breadth and depth of mathematical knowledge needed to make intelligent curricular decisions and to teach with confidence, while teachers well qualified to teach the traditional school program need advanced study to cope with the changing nature of mathematics.

In April, 1984 the British Columbia Association of Teachers of Mathematics (BCAMT) issued a report on the qualifications of mathematics teachers in that province. It was reported that the province did not require its teachers teaching mathematics to have taken any academic courses in mathematics. An indication of an informal, de facto minimum requirement was seen in the fact that Algebra 11 is required for admission to all faculty of education programmes in the provincial universities. Although about 90% of senior secondary teachers teaching mathematics have some post-secondary education in mathematics, similar statistics for teachers of mathematics at the elementary and junior secondary levels were not reported. With respect to education courses in the teaching of mathematics, the situation was that there were no provincial requirements, but that the universities required a certain course of all elementary candidates and certain other courses and practica of those students specializing in mathematics at the secondary level. The report concluded that "many teachers without sufficient mathematics skills are being asked to teach mathematics in the classrooms of this province."

Regarding in-service professional development for mathematics teachers,

the BCAMT report noted that many opportunities were provided, but that in 1981 only 30% of junior secondary mathematics teachers had attended a mathematics conference or workshop in the previous three years. The report went on to predict that as budgetary restrictions continued there would be continuing losses in the number of professional development days, in the salary and other incentives given to teachers obtaining additional qualifications, and in the number of professional staff available to conduct in-service workshops.

More recently, an article appeared in the September 2, 1985 issue of Alberta Report, with the title "The great math debacle: Woeful Grade 12 exam scores bring hard charges, soft excuses." The article claimed that there is in Alberta "a chronic shortage of qualified math teachers, largely because students who excel in this area tend to pursue more lucrative careers such as engineering and computer research." Noting that teachers are trained in specific subject areas but certified as generalists, able to teach any subject to any grade, the article implied that an unspecified number of Alberta mathematics classes are being taught by incompetent teachers. On the other hand, Dr. Lawrence Rappel, Alberta Education director of teacher certification and development was quoted as saying that

> "The instances of unqualified teachers instructing math classes are rare. Besides, all teachers certified since 1974 are better qualified, having completed a four-year education program (rather than the previous three-year one), 60% having taken at least three university math courses."

Unfortunately the assertions on the two sides of the issue do not make clear what is meant by the terms "qualified" and "certified" nor to what group of teachers the 60% figure refers. However, Dr. Rappel was not refuted when he made the point that "a change in policy [to subject- or grade- specialist certification of teachers] would especially hurt rural schools that require instructors capable of teaching several subjects to several grades and would be hard-pressed to attract or afford more specilized help."

Finally, the continuing discussion of and reaction to the "Review of Secondary Programs" presented in 1985 by the Minister of Education's Advisory Committee has focussed Albertans' attention on the nature of secondary education in the province. Since one of the outcomes of the Review is likely to be that in the future more students will take more high school mathematics, the availability of qualified mathematics teachers may become an increasingly important issue.

It was in this climate of controversy and alarmist public discussion that in 1985 MCATA chose to take the action of commissioning the present study. Its purpose is to provide valid, reliable, and current information to determine the extent to which some of the undesirable situations in mathematics education identified above are actually being experienced in Alberta. To the extent that they are, specific problem areas can be identified so that action can be taken to meet particular needs. If, however, the current situation in Alberta is not as the critics have painted it, those facts ought to be publicized in order to build up confidence in education in the Province. The facts, analyses, and interpretations contained in this report are presented so that readers can draw their own conclusions and take

the actions they consider most appropriate.

QUESTIONS INVESTIGATED

To fulfill the purposes set out for it, the study sought to answer the following questions.

1. What course requirements have been recommended for elementary and secondary mathematics teachers-in-training, in mathematics content and mathematics teaching methods? What are the Alberta universities' course requirements in these areas?

2. What courses in mathematics (content) and mathematics education (methods) have been completed by teachers currently teaching mathematics in Alberta?

3. What is the nature and amount of teachers' recent participation in continuing professional education related to mathematics? (e.g., in-service courses, workshops, professional development sessions, etc.)

4. What professional organizations do mathematics teachers belong to?

5. What facilities are available in schools to support mathematics teaching? (e.g.,"math labs," journals about mathematics teaching, class sets of calculators, computer hardware and software, etc.)

6. What are the opinions of principals and mathematics teachers regarding the availability and quality of materials and services which support the teaching of mathematics? (e.g., curriculum guides; print, manipulative, and computer materials for students and for teachers; calculators and computers; consultants' services; opportunities for in-service education; etc.)

METHODOLOGY

Question 1 was investigated by reviewing the recommendations made by professsional organizations concerning the pre-service and in-service training of teachers, and by perusing the most recent calendars of the three universities in the province that offer teacher education programs. The remaining questions were studied by means of questionnaires that were sent to representative samples of principals and teachers across the province.

Samples

The study was performed in two parts: elementary and secondary. A stratified random sample of 100 Alberta elementary schools and a similar sample of 100 Alberta secondary (junior high, senior high and junior/senior high) schools were drawn to represent the balance among small/large, public/separate, and urban/rural schools in the province. The decision to base the distribution of questionnaires on schools rather than on individual teachers was taken for reasons of economy and convenience, in order to obtain a "snapshot" of the characteristics of schools, and to assure that there would

be an adequate sampling of principals' opinions. Questionnaires were sent to the principal with a covering letter explaining survey's purposes and asking for the support of the staff. In elementary schools all teachers were asked to respond; in secondary schools all teachers teaching mathematics were asked to respond.

Instruments

Three separate questionnaires were constructed, one for principals, one for elementary teachers, and one for secondary teachers. Copies of the three instruments are available on request.

The form sent to principals had five major parts. It requested

(1) general information about the school, such as number of students, number of teachers, and grades included,

(2) information about the school's mathematics teaching facilities including "math labs," class sets of calculators, and journals about teaching mathematics,

(3) information about the microcomputer hardware and software available in the school,

(4) information regarding professional development, in particular whether the principal encourages teachers to join professional organizations and to take part in continuing professional development activities related to mathematics, and

(5) the principal's opinions concerning the areas in which there are needs to improve the mathematics teaching in the school.

The questionnaires distributed to elementary teachers and to secondary teachers were similar, but not identical. Each had five major parts:

(1) personal information -- sex, age, years of teaching experience;

(2) current teaching responsibilities -- full-time/part-time; principal, assistant principal, vice principal, department head; grades and subjects taught; and (for secondary teachers only) percentage of total teaching time devoted to mathematics teaching;

(3) pre-service education -- degrees held; university courses taken in mathematics teaching methods, mathematics content, computer applications, computer languages, other teaching methods;

(4) continuing professional education -- sessions, workshops, and courses related to mathematics teaching attended during the past three years; and

(5) opinions about the adequacy of the support for mathematics teaching -- availability and helpfulness of curriculum guides, prescribed texts, supplemental materials, journals, teacher guides, and manipulative materials; diagnostic, referral, and consultant services; in-service opportunities; and

calculators and computers (hardware, software, and student activities).

FINDINGS

Recommended Qualifications

Recommendations regarding desirable qualifications for teachers of mathematics have been made by the National Council of Teachers of Mathematics (NCTM) and by the Mathematical Association of America through its Committee on the Undergraduate Program in Mathematics Panel on Teacher Training (CUPM Panel). The NCTM recommendations are in the form of rather general guidelines issued in 1973, but the CUPM recommendations presented in 1983 are relatively concrete, giving descriptions of individual courses, and including course objectives, time allocations to major topics, and suggested textbooks.

The courses recommended by the CUPM Panel are of three semester credit hours each. At the University of Alberta such a course is referred to as a "3-credit course," at the University of Calgary such a course is termed a "half course" (because it is half of a full-year course), and at the University of Lethbridge such a course is called simply a "course." Because different organizations may use the same terms with different meanings, it is important to emphasize that in this report the term "course" will mean a three semester credit hour course.

The CUPM Panel recommendations are as follows.

Level I -- Teachers of elementary school mathematics.

Two or three of the following:

- Fundamental Mathematical Concepts I
- Fundamental Mathematical Concepts II
- Geometry for Elementary and Middle School Teachers
- Algebra and Computing for Elementary and Middle School Teachers

Level II -- Elementary school mathematics specialists, coordinators of elementary school mathematics programs, and teachers of middle school and junior high school mathematics.

A minimum of nine courses as follows:

- All four of the courses listed for Level I
- An introduction to calculus (1 course)
- Four more courses, selected from the Level III list which follows

Level III -- Teachers of high school mathematics.

At least the following 13 courses or their equivalent:

- Discrete Mathematics
- Calculus Sequence (three courses)
- Introduction to Computing

Mathematics Appreciation
Linear Algebra
Probability and Statistics
Number Theory
Geometry
Abstract Algebra
History of Mathematics
Mathematical Modelling and Applications

In addition to these requirements in mathematics content the report states that all students preparing for elementary school teaching are expected to complete at least one course in the methods of teaching mathematics at the elementary school level. Interestingly, a parallel requirement of methods course(s) for secondary mathematics teachers is not mentioned.

Universities' Requirements

Three universities in Alberta offer teacher education programs, The University of Alberta, The University of Calgary, and The University of Lethbridge. Although there are differences between their programs, each institution offers a four-year Bachelor of Education (B. Ed.) degree, a Bachelor of Education program for holders of approved degrees (B. Ed. After Degree), and various diploma and master's programs. The University of Calgary and The University of Lethbridge also offer five-year programs in certain areas that combine a B. Ed. degree with a bachelor's degree in arts, science, music, or general studies. The University of Alberta and The University of Calgary have separate "routes" for elementary education, secondary education, and other specializations; University of Lethbridge programs are specialized by subject major but not by grade level.

University of Alberta programs preparing elementary teachers are generalist programs, but some level of specialization is permitted by choice of options. Minors are offered, but not required. There is currently no minor in mathematics education.

All elementary education students in the four-year program are required to take at least one course in mathematics content. Math 261, "Higher arithmetic," which is restricted to elementary education students and has Math 30 as a prerequisite, is taken by most students. Math 371, "Topics in mathematics: Problem solving in different areas of mathematics," is also offered for students who have taken Math 261. Elementary education students in the B. Ed. After Degree program are not required to have taken a university level mathematics content course; mathematics is one of seven areas of which five are required.

Mathematics methods (curriculum and instruction) courses required of all elementary education students are available either as a separate course (2 credits) or as one part of an integrated core module. Five additional optional courses at the undergraduate level in elementary mathematics education are offered. These emphasize specific topics such as mathematics curriculum, diagnostic teaching, and lab procedures and materials. Courses are offered at the graduate level as well.

All students in the 4-year B. Ed. secondary program must have a teaching major, and may arrange to have a teaching minor. The mathematics major consists of at least 12 courses in mathematics content plus 2 courses in mathematics education; the mathematics minor consists of at least 5 courses in mathematics content plus 1 course in mathematics education. There are additional requirements that ensure that the programs have both depth and breadth.

Students in the B. Ed. After Degree program must have on admission a teaching major of at least 10 courses and a teaching minor of at least 2 courses. Mathematics may be chosen as either a major or minor. The mathematics methods requirement for majors in the B. Ed. After Degree program is 2 courses.

Eight different courses treating various aspects of secondary school mathematics curriculum and instruction are offered at the undergraduate level. Courses are offered at the graduate level as well.

University of Calgary programs preparing elementary teachers are generalist programs. However, 4-year B. Ed. (but not B. Ed. After Degree) students are required to have a specialized major. There is no requirement of a university level mathematics content course for all students, but Math 30 is normally a requirement for admission to the Faculty of Education. Students choosing to major in mathematics are required to choose at least six courses from the areas of mathematics, statistics, and computer science.

All elementary route students are required to take one course in mathematics education. This course, which is taken during the practicum year, deals with curriculum and teaching methods in elementary mathematics, and includes field experiences and laboratory activities. Two optional courses in elementary mathematics education are offered at the senior undergraduate level. Both of these courses are required of mathematics majors. Additional courses are offered at the graduate level.

All students in the 4-year B. Ed. secondary program must have a teaching major, and may arrange to have a teaching minor. The mathematics content major consists of at least 14 courses in mathematics, statistics, computer science, and related fields; the mathematics content minor consists of at least 6 courses in mathematics and related fields. Specific course requirements and distribution requirements ensure that the programs have both depth and breadth. To be admitted to a B. Ed. After Degree program a student must have taken the academic content of the corresponding 4-year B. Ed. program, or equivalent.

Students who major in secondary mathematics are required to take two courses (actually a single "full-year" course) in mathematics teaching methods during their practicum year. An additional optional "full-year" course at the senior undergraduate level in secondary mathematics education is also offered, and there are graduate level courses as well.

The University of Lethbridge does not offer differentiated programs for elementary and secondary teachers, but all students must have a teaching major

and a teaching minor or second teaching major. The mathematics major consists of ten mathematics content courses, some required, some recommended, some optional. The mathematics minor consists of five courses, two required, three optional. Requirements are structured to ensure both breadth and depth.

The mathematics curriculum and instruction (methods) course required of majors is a double course (6 credits). A similar course (3 credits) for non-majors (including minors) is also offered. An advanced undergraduate level curriculum and instruction course is also available. Students who do not major or minor in mathematics get some exposure to mathematics teaching in a generic methods of teaching course.

Summary. Only The University of Alberta has a university level mathematics content requirement for elementary education students, and then only for students in its 4-year program. At the other universities high school mathematics (usually Math 30) is the highest level required. Except at the University of Lethbridge, all prospective elementary school teachers take at least one course in mathematics curriculum and instruction.

All three universities have clearly defined majors and minors in mathematics for secondary school teachers. The mathematics content requirement for a major is 14 courses at The University of Calgary, 12 courses in the University of Alberta 4-year program, and 10 courses at The University of Lethbridge and in the University of Alberta B. Ed. After Degree program. For minors the mathematics content requirement is 6 courses at The University of Calgary, 5 courses at The University of Alberta, and 2 courses at The University of Lethbridge. All three universities require secondary mathematics majors to take two courses in mathematics curriculum and instruction and require secondary mathematics minors to take at least one mathematics education course.

Questionnaire Results

Rates of Return. Questionnaires were sent to the principals of 100 elementary schools and 100 secondary schools; responses were received from 70 elementary schools and 67 secondary schools. Rates of return were analyzed for each of the largest school districts, and in terms of urban and rural classifications. Although the return rates varied from a high of 100% in one subgroup to a low of 50% in another, most were in the 60% - 90% range, and it was concluded that the sample of schools was sufficiently large and representative.

Teachers' questionnaires were returned by 477 elementary teachers and 241 secondary teachers. It is difficult to estimate what percentage of the target group of teachers actually replied to the questionnaires, but the average of 6.8 teacher responses per elementary school compares favorably with the average reported staff size of about 14 full-time equivalents. Although the return rate of 3.6 teachers per secondary school against a mean staff size of about 28 full-time equivalents may seem low by comparison, it should be remembered that only mathematics teachers were asked to respond to the secondary quesionnaire.

Schools' Characteristics

The "average" (median) school in the elementary sample had between 100 and 300 students, 13 full-time teachers, and 2 part-time teachers. The average secondary school had between 300 and 500 students, 22 full-time teachers, and 1 part-time teacher. Interestingly, about 20% of the elementary sample schools also included classes in Grades 7 to 9 and about 7% of them included classes in Grades 10 to 12. Of the secondary schools, about 35% included elementary classes, about 75% included classes in Grades 7 to 9, and about 45% included classes in Grades 10 to 12.

Specially equipped classrooms designated as "mathematics laboratories" were quite rare; only 2 of the elementary and 4 of the secondary schools reported having them. More common were microcomputer laboratories, which were found in 38% of the elementary schools and 82% of the secondary schools. Nearly all schools, 96% of each group, had at least one microcomputer in the school; 59% of the elementary schools and 90% of the secondary schools had five or more, and 23% of the elementary schoools and 76% of the secondary schools had ten or more computers in the school. Class sets of calculators (20 or more) were available in 50% of the elementary schools and in 39% of the secondary schools.

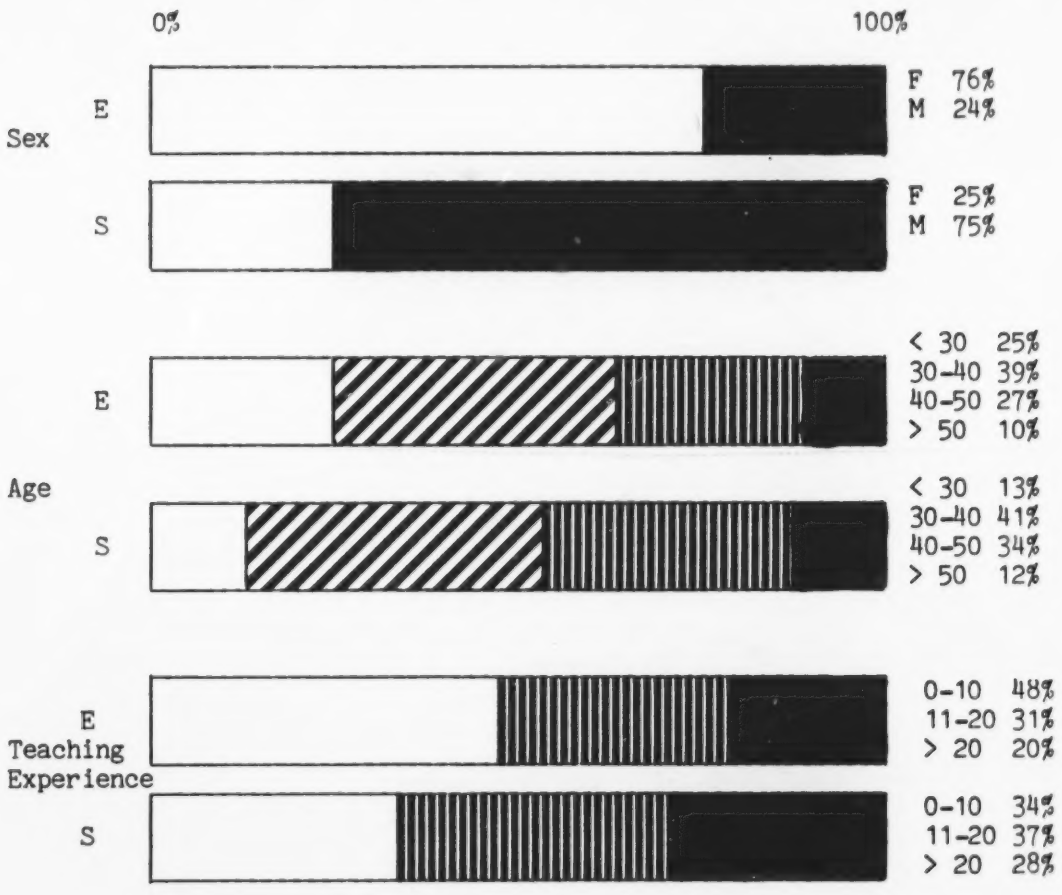
The most commonly found types of computer software were drill and practice programs (in 86% of the elementary schools and 70% of the secondary schools) and word processors (in 50% of the elementary schools and 67% of the secondary schools). Logo programming language software was available in 58% of the elementary schools and 43% of the secondary schools. Spread sheet programs and mark book programs were fairly common in secondary schools (59% each), but not in elementary schools (23% and 22% respectively).

Most of the schools, 56% of the elementary and 78% of the secondary, had a teacher serving formally or informally as the mathematics department head or mathematics coordinator. Most of the schools, 61% of the elementary sample and 55% of the secondary sample, did not receive any journals about mathematics teaching, but 29% of the elementary schools received the Arithmetic Teacher and 33% of the secondary schools received the Mathematics Teacher. Very few schools subscribed the the MCATA journal delta-K (only 3% of the elementary schools and 8% of the secondary schools).

Teachers' Personal Characteristics

The graphs in Figure 1 give information on the sex, age, and number of years of teaching experience of respondents in the elementary and secondary subgroups. About three-quarters of the elementary teachers were female and about one-quarter were male, while for the secondary teachers the opposite was the case. The distributions of teachers' ages and number of years of teaching experience were similar in the two groups, but the secondary teachers were somewhat older and more experienced. The median age in both groups was in the 30 to 40 years category, but the median number of years of teaching experience was 11 in the elementary sample and 15 in the secondary sample.

Figure 1: Personal Characteristics of Respondents



The vast majority of respondents, more than 85% in both samples, were full-time teachers; less than 5% were part-time teachers, principals, assistant or vice principals, or department heads. The elementary teachers were almost all generalist teachers; specialists in art, music, physical education, special educaion, foreign languages, language arts, and mathematics comprised about 12% of the of the sample in all, and no one of the specialties represented more than 4% of the sample.

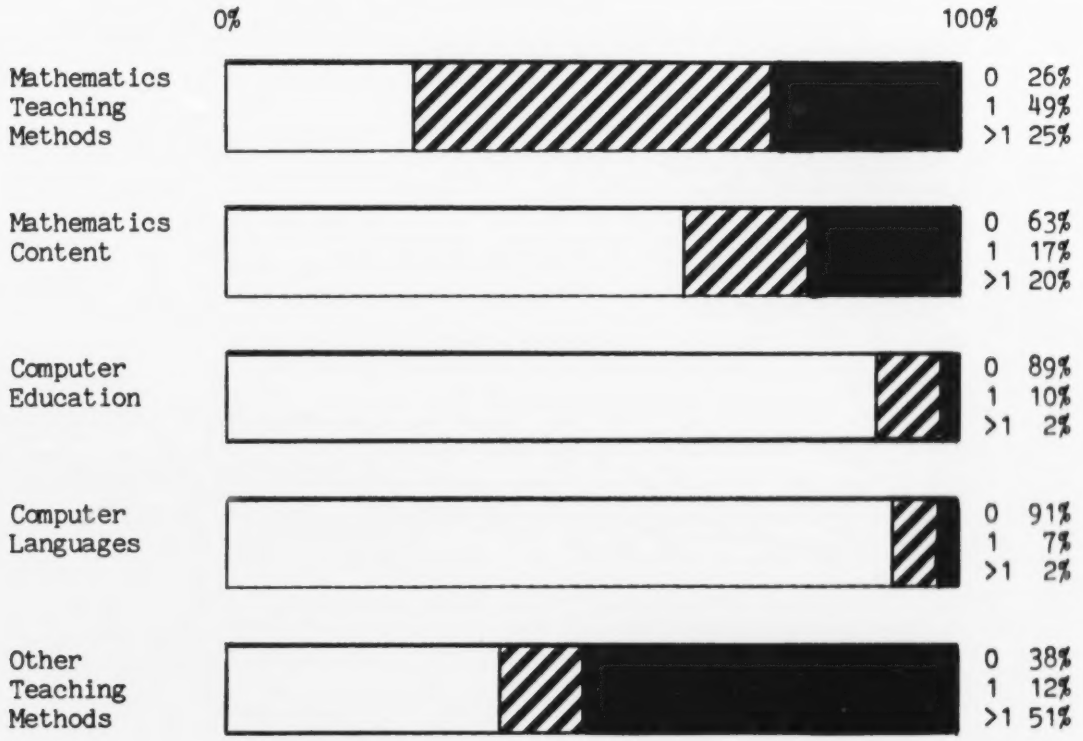
Of the secondary teachers about one-third reported teaching at least one class of the junior high school mathematics program, and about one-quarter reported teaching at least one class in the academic stream senior high school program (Math 10, 20, 30). About one-quarter of the sample taught at least one computer course or option. Secondary teachers were also asked to indicate what percentage of their total teaching time was spent teaching the mathematics courses listed on the questionnaire. The average (mean) value for this figure was 68% for the entire secondary sample, but it tended to be higher for urban teachers than for rural teachers, and higher for teachers with more mathematics in their preparation for teaching.

Teachers' Pre-service Education

The main course components of elementary teachers' and secondary teachers' university preparation related to mathematics are shown in Figures 2 and 3 respectively. In each graph the three colors represent the percentages of respondents who had taken none, one, or more than one of each type of course.

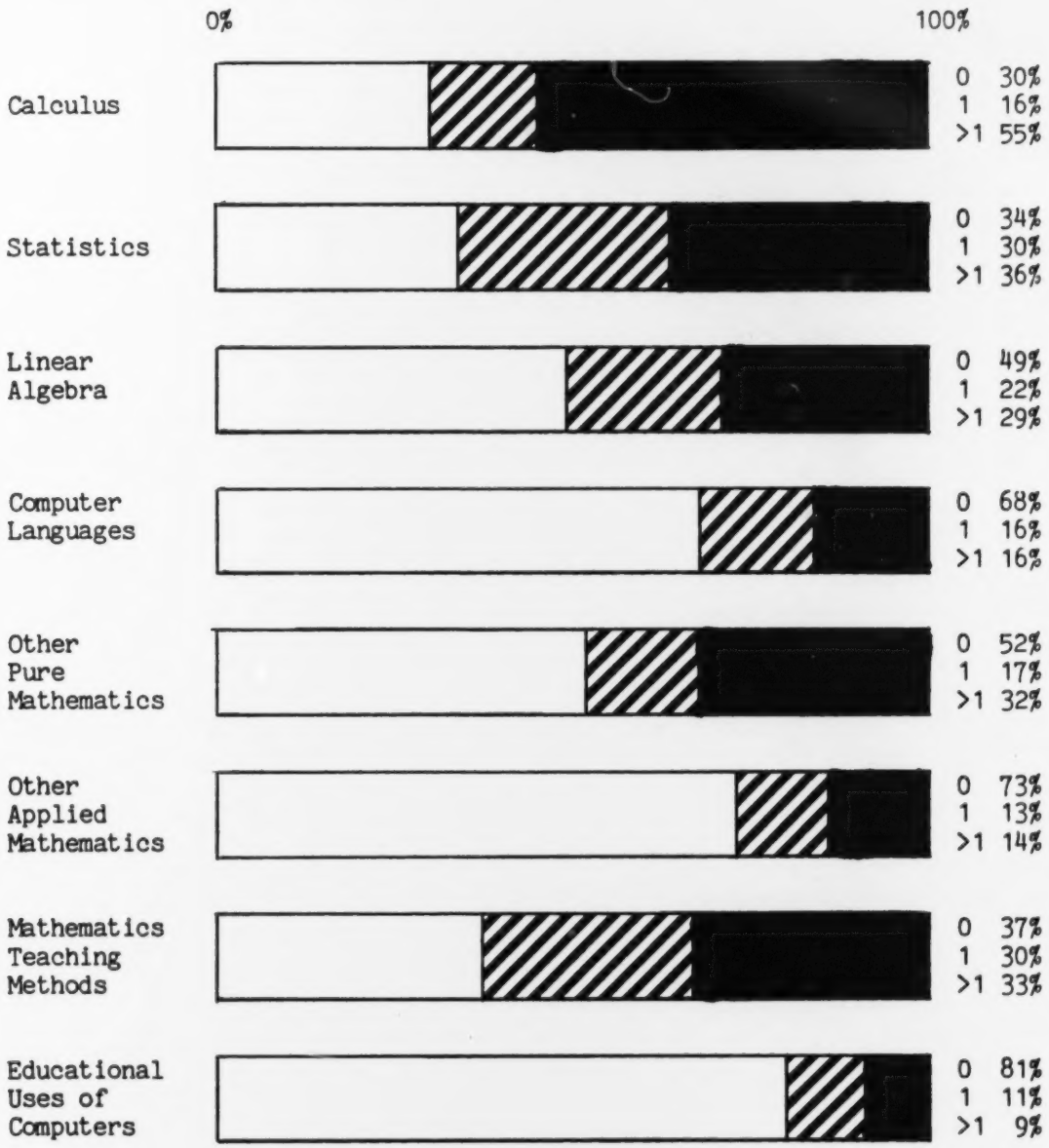
The graphs in Figure 2 indicate that a majority of the elementary teachers had taken one or more mathematics teaching methods courses and a majority had taken one or more other teaching methods courses. But they also show that more than one-quarter of them had not taken a mathematics education course and more than one-third had not taken a methods course in another area. Only about one-third of the elementary teachers had taken a mathematics content course at university level, and only about one-tenth had studied computer languages or computer applications.

Figure 2: Elementary Teachers' Pre-Service University Courses



The graphs of Figure 3 suggest that most secondary mathematics teachers had taken one or more courses in calculus, statistics, and mathematics teaching methods. Teachers in the sample were less likely to have studied linear algebra, pure and applied mathematics beyond calculus, and computer languages and applications. More than one-third of the respondents indicated that they had not taken even one course on the methods of teaching mathematics.

Figure 3: Secondary Teachers' Pre-Service University Courses



The questionnaires also enquired about the university courses teachers had taken as post-graduates. In the elementary sample more than 95% of the teachers indicated that they had not taken courses in mathematics content, mathematics education, computer languages, or computer applications in education at this level. In the secondary sample only about 15% of the teachers had taken post-graduate courses in mathematics content or mathematics education, and only about 10% had taken post-graduate courses in computer languages or computer applications.

Since the universities offer clearly defined majors and minors in mathematics, and since these designations are readily understood by members of the public as well as professionals, a number of aspects of the the data for secondary school teachers were analyzed in terms of whether the teachers had qualifications at least equivalent to a major in mathematics, at least equivalent to a minor in mathematics, or less than a minor in mathematics. For the purpose of these analyses, a mathematics major was defined as 10 or more courses in mathematics content plus 2 or more courses in mathematics education, and a mathematics minor was defined as at least 6 courses in mathematics content plus at least 1 course in mathematics education.

Overall, 35% of the secondary mathematics teachers had the equivalent of a mathematics major, 22% more had the equivalent of a mathematics minor, and 42% had less than a mathematics minor. The results of the analyses also support the following conclusions.

(1) Teachers who teach senior high school mathematics classes tend to have higher qualifications in mathematics than teachers of junior high school mathematics classes.

> 49% of all senior high school mathematics teachers in the sample had the equivalent of a mathematics major, 23% of all junior high school teachers had a major.
>
> 31% of the senior high school mathematics teachers had less than a minor in mathematics; 53% of the junior high school teachers had less than a minor.

(2) Teachers who teach academic stream senior high school classes (Math 10, 20, 30, 31) tend to have higher levels of qualifications than teachers of all senior high school mathematics courses.

> 57% of the teachers teaching Math 10, 20, 30, or 31 had the equivalent of a mathematics major; 49% of all high school mathematics teachers had a major.

(3) Teachers who teach mathematics in urban schools tend to have higher levels of qualifications than teachers of mathematics in rural schools.

> 42% of the urban secondary mathematics teachers had a major; 25% of the rural secondary mathematics teachers had a major.
>
> 56% of the urban senior high school mathematics teachers had a major; 38% of the rural senior high school mathematics teachers had a major.

(4) Teachers with higher levels of mathematics qualifications tend to teach more mathematics (as a percentage of their total teaching load).

> Teachers who had the equivalent of a mathematics major devoted an average of 88% of their teaching load to teaching mathematics

classes; teachers who had the equivalent of a minor spent an average of 69%; teachers with less than a minor in mathematics spent an average of 49% of their teaching time on mathematics.

(5) Teachers of mathematics in urban schools tend to have a larger percentage of their teaching load in mathematics than do teachers of mathematics in rural schools.

For urban secondary mathematics teachers the median percentage of teaching load devoted to mathematics teaching was 86%; for rural secondary teachers it was 50%.

Teachers' In-service Education

Teachers in both the elementary sample and the secondary sample were asked to indicate the number of continuing professional development (in-service) activities related to mathematics they had participated in in each of the previous three academic years. The activites were defined as "sessions," about a half day in length; or as "workshops," about a whole day long; or as "courses," longer than one day.

When the past three years were considered together and averages per year were computed, it was found that only about 25% of the teachers had attend one or more sessions, only about 10% of the teachers had attended one or more workshops, and less than 10% of the teachers had attended one or more courses in a typical year.

When the total number of sesions, workshops, and courses taken in all three years were added together, it was found that 34% of the elementary teachers and 36% of the secondary teachers and not participated in any of these activities in any of the previous three years. The median number of in-service activities per teacher was about one in the entire three year period.

Teachers' Membership in Professional Organizations

Teachers were asked to indicate to which of the following professional organizations they belonged: National Council of Teachers of Mathematics (NCTM), Mathematics Council of the Alberta Teachers' Association (MCATA), Alberta Teachers' Association Computer Council (ATACC), other ATA specialist councils, and other professional organizations. The percentages of each group that indicated membership in each organization were as follows.

NCTM	1% of elementary teachers,	13% of secondary teachers.
MCATA	1% of elementary teachers,	17% of secondary teachers.
ATACC	6% of elementary teachers,	11% of secondary teachers.
Other ATA Council	21% of elementary teachers,	13% of secondary teachers.
Other organization	11% of elementary teachers,	8% of secondary teachers.

Principals were asked, "Do you encourage teachers on your staff to join mathematics education professional organizations such as the Mathematics Council of the ATA?" and 68% of the elementary principals and 80% of the secondary principals who responded replied "yes." Principals were also asked

"Do you encourage teachers on your staff to participate in continuing professional development activities related to mathematics teaching?" and 87% of the elementary principals and 95% of the secondary principals who replied indicated "yes."

Teachers' Opinions About Support For Mathematics Teaching

Teachers in both the elementary and secondary samples were asked to give their opinions regarding the adequacy of certain materials and services that support their teaching of mathematics by indicating whether they thought the support was "more than adequate," "adequate," or "inadequate." The table below gives the percentage of teachers in each sample that chose each response.

Table: Elementary Teachers' and Secondary Teachers' Ratings of the Adequacy of Support for Mathematics Teaching

	More than Adequate		Adequate		Inadequate	
	E	S	E	S	E	S
Availability of Alberta Curriculum Guides	43%	44%	54%	51%	1%	2%
Helpfulness of Alberta Curriculum Guides	16%	14%	75%	73%	3%	7%
Availability of Prescribed Texts	27%	23%	63%	64%	6%	7%
Quality of Prescribed Texts	12%	5%	72%	47%	10%	41%
Availability of Supplemental Texts/Workbooks for Students	12%	8%	56%	46%	26%	39%
Availability of Teacher Guides and Ideabooks	17%	10%	62%	50%	17%	35%
Availability of Manipulative Materials	9%	2%	52%	42%	33%	43%
Availability of Diagnostic Tests	4%	2%	46%	39%	40%	48%
Availability of Referral Services	4%	3%	49%	48%	32%	34%
Help and Advice from Consultants	13%	10%	54%	57%	22%	20%
Inservice About Teaching Particular Mathematics Topics	8%	3%	50%	42%	32%	42%
Availability of Mathematics Periodicals (e.g. Mathematics Teacher, delta-K)	3%	3%	48%	65%	32%	17%
Availability of Calculators for Student Use	8%	8%	38%	51%	35%	32%
Availability of Computer Hardware	13%	10%	39%	46%	31%	30%

	More than Adequate		Adequate		Inadequate	
	E	S	E	S	E	S
Word Processing Software	8%	7%	30%	31%	30%	29%
Data Base Management Software	3%	4%	15%	25%	31%	28%
CAI Software for Students	3%	1%	16%	15%	31%	39%
CAI Authoring Language (for Teachers)	2%	1%	11%	14%	29%	36%
Demonstration Software (e.g., graphing utilities)	--	1%	--	19%	--	37%
Mark-book Software	2%	6%	15%	35%	31%	20%
Logo Language Software	7%	2%	29%	23%	25%	25%
Student Programming Activities in BASIC	4%	6%	21%	30%	28%	23%
Student Programming Activities in Logo	6%	2%	25%	17%	27%	27%
Inservice About Using Computers in Mathematics	8%	4%	30%	27%	33%	39%

The entries in this table are difficult to interpret becuase there are so many of them. In general it may be said that the teachers were satisfied with the availability and quality of curriculum guides and textbooks. However, the secondary teachers were noticeably less satisfied with the quality of their textbooks than were their elementary counterparts; 41% of the secondary sample teachers felt the quality of their texts was inadequate. Comments added by the respondents suggest that the it was the junior high school mathematics texts that were of greatest concern.

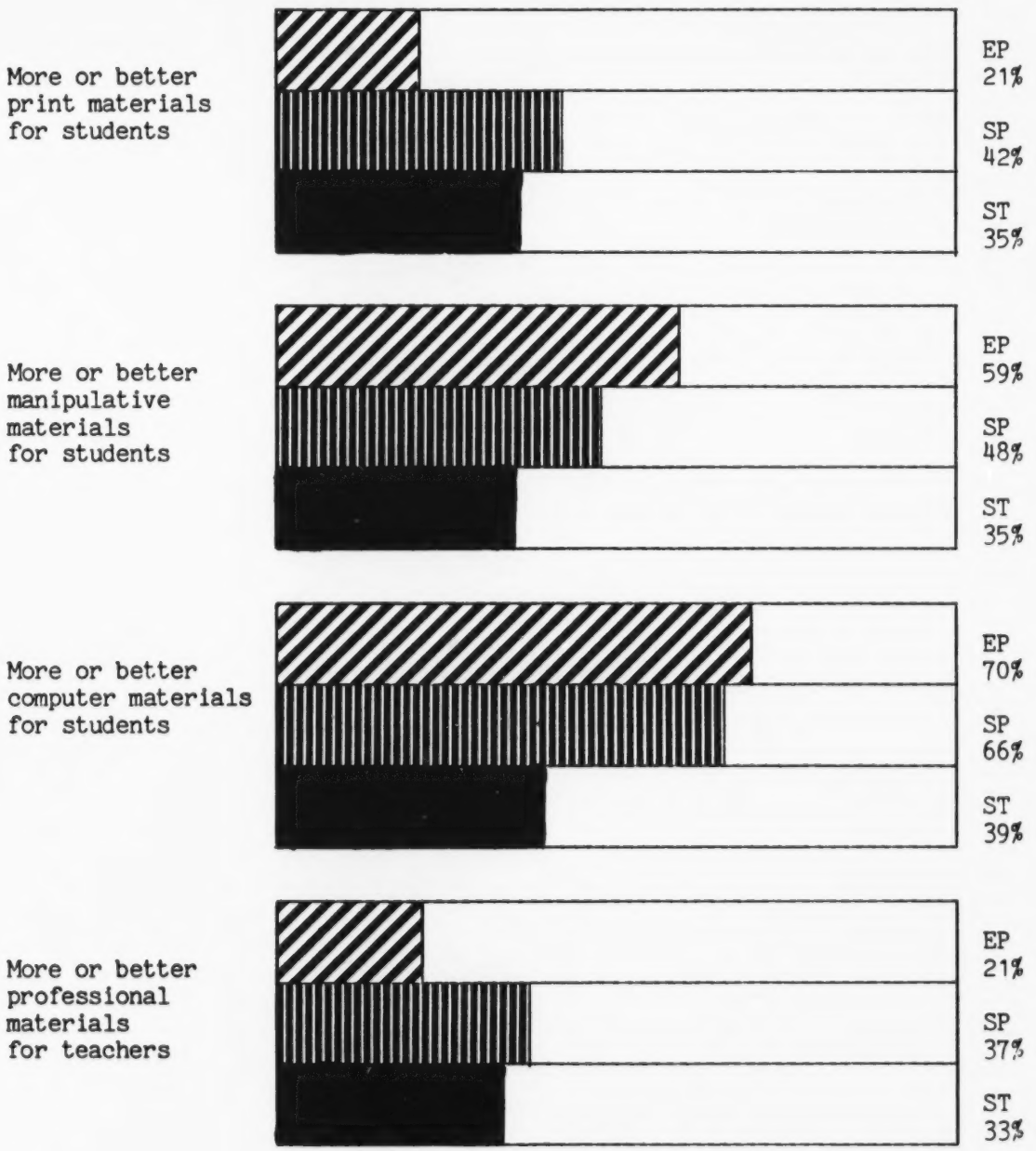
Opinions about supplementary materials, manipulative materials, diagnostic tests, referral services, consultant services, and in-service offerings were mixed. There was also no clear consensus in teachers' views regarding calculators, computers, and the various types of computer software. In some of these areas fairly large percentages of the teachers gave no response.

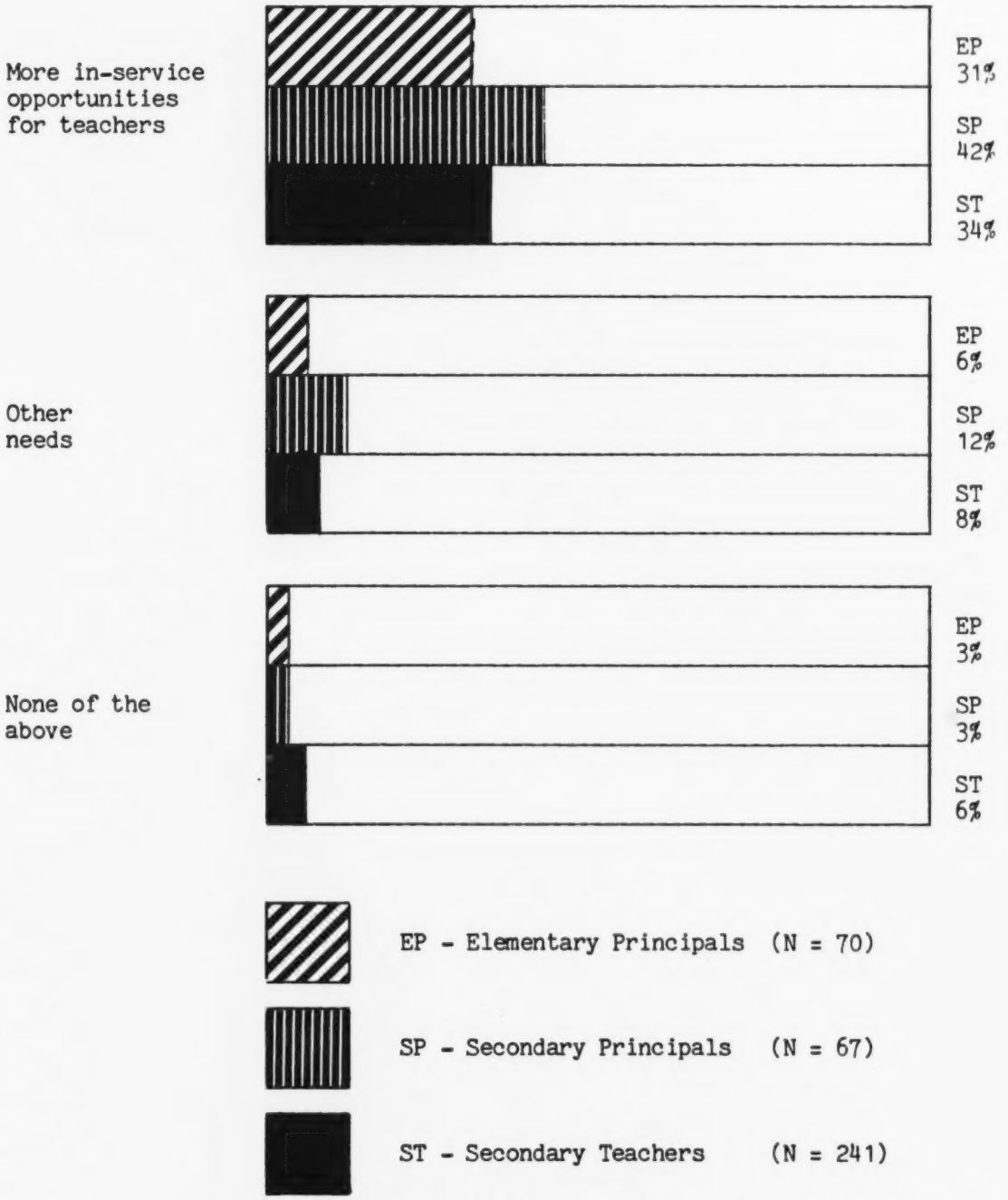
Principals' and Teachers' Identification of Needs

Elementary principals, secondary principals, and secondary teachers, but not elementary teachers were asked to indicate whether they thought that there were needs to improve the mathematics teaching in their schools in five suggested areas. The areas named were "more or better print materials for students," "more or better manipulative materials for students," more or better computer materials for students," "more or better professional materials for teachers," and "more in-service opportunities for teachers."

Respondents were invited to select as many areas as they felt needed improvement, to indicate other areas of need, or to indicate that they believed that there were no areas of need to improve the mathematics teaching in their school. The results from these items are displayed in Figure 4.

Figure 4: Percentage of Elementary Principals, Secondary Principals, and Secondary Teachers Identifying Areas of Need to Improve Mathematics Teaching.





These graphs suggest that while substantial minorities of the respondents chose each of the areas as an area of need, there was no clear consensus regarding the most important needs. The areas of need suggested in response to the "other needs" category were quite diverse, and included items such as funding for various projects and activities, and the development of materials for the gifted and materials for students with special needs.

Concluding Comments

The facts contained in this report serve to emphasize that the real world of principals, teachers, and students is not an ideal world in which we might wish teachers to have broad academic backgrounds and extensive professional training, schools to provide a full range of high quality supporting materials and services, and professional organizations to involve every teacher with their professional development activities and publications on a regular and continuing basis. Two unanswered questions are "Which of the discrepancies between the ideal and the real are most important to change?" and "How can the desired changes be brought about?" This report will be of benefit only if it helps its readers, both individually and corporately, to consider the issues and to formulate plans for action to meet the needs identified.

CALL FOR ACTION

This Final Report has been distributed to all members of the Mathematics Council of the Alberta Teachers' Association, to the principals and teachers who took part in the survey, and to interested individuals in schools, school district offices, universities, and Alberta Education. Now the Mathematics Council must consider what actions need to be taken to address the issues raised in the report.

In this process all interested parties are being invited to give their reactions. Early in 1987 the Mathematics Council plans to publish a collection of papers recommending specific actions to be taken by MCATA and others concerned with mathematics education in Alberta. Colleagues who wish to participate in this activity are asked to send their contributions before March 15, 1987 to:

Thomas L. Schroeder
Curriculum & Instruction Dept.
Faculty of Education
University of Calgary
Calgary, Alberta T2N 1N4

APPENDIX: Principals' Form

Elementary Teachers' Form

Secondary Teachers' Form

Survey of Alberta Mathematics Teachers

School Information from Principal

1. Jurisdiction: [] Calgary Public [] Edmonton Public
[] Calgary Separate [] Edmonton Separate
[] Other (specify)

2. Number of Students: [] under 100 [] 100 to 300
[] 300 to 500 [] 500 to 1000 [] over 1000

3. Grades Included: [] ECS [] 1 [] 2 [] 3 [] 4 [] 5 [] 6
[] 7 [] 8 [] 9 [] 10 [] 11 [] 12

4. Number of Teachers (including Principal, V. P., and A. P.):

____ Full-time teachers ____ Part-time teachers

____ Full-time equivalents (including full-time and part-time)

5. Mathematics Teaching Facilities:

Is there a specially equipped classroom that is used as a "math lab" in your school? [] Yes [] No

Is there a class set (20 or more) of hand calculators for student use? [] Yes [] No

Does your school receive journals about mathematics teaching? (Check any that apply.)

[] Arithmetic Teacher [] Mathematics Teacher
[] delta-K (MCATA publication) [] Other (specify)

Is there a teacher on your staff who serves (formally or informally) as a mathematics department head or mathematics coordinator? [] Yes [] No

6. Micro-computer Systems:

____ Total number in the school
____ Number used primarily in the school office
____ Number used primarily in computer lab(s)
____ Number rotating among classes on a short-term basis
____ Number assigned to one class for more than a day at a time

7. Types of Computer Software available (Check any that apply):

[] Word processors for school staff
[] Word processors for student use
[] Spread sheets
[] Data base management systems
[] Mark-book programs
[] Drill & Practice for students
[] Tutorials for students
[] CAI authoring language
[] Logo programming language

8. Professional Development:

Do you encourage teachers on your staff to join mathematics education professional organizations such as the Mathematics Council of the ATA? [] Yes [] No If yes, how?

Do you encourage teachers on your staff to participate in continuing professional development activities related to mathematics teaching? [] Yes [] No If yes, how?

9. Needs:

In which of the following areas do you think there is a need to improve the mathematics teaching in your school? (Check any that apply.)

[] More or better print materials for students
[] More or better manipulative materials for students
[] More or better computer materials for students
[] More or better professional materials for teachers
[] More in-service opportunities for teachers
If so, on what topic(s)?

[] Other needs (specify)

[] None of the above

Survey of Alberta Mathematics Teachers

Information from Elementary Teachers

1. Personal Information

Sex: [] Female [] Male

Age: [] Under 30 [] 30 - 40 [] 40 - 50 [] Over 50

Number of Years of Teaching Experience ____

2. Current Teaching Responsibilities

[] Full-time teacher [] Part-time teacher
[] Principal [] Asst. or Vice Principal

Please check appropriate cells in the table below to show the grades and subjects you are now teaching.

Subjects	Gr 1	Gr 2	Gr 3	Gr 4	Gr 5	Gr 6	Other Grade(s) (specify)
Language Arts							
Mathematics							
Social Studies							
Science							
Art							
Music							
Physical Educ.							
Special Educ.							
Other subject(s) (specify)							

3. Pre-service Education

Which of the following degrees do you hold?

[] B. A. [] B. Sc. [] B. Ed. (3- or 4-year) [] B. Ed. (after)

[] Other Bachelor (specify) _____ [] Dip. Ed.

[] M. Ed. [] M. A. [] M. Sc. [] Other (specify) _____

In your preparation for teaching how many university "courses" did you take in each of the following subject areas? (By "course" we mean a one-semester course for three hours a week. This is called a "3-credit course" at the University of Alberta and a "half course" at the University of Calgary.)

_____ Mathematics Teaching Methods
_____ Mathematics Content (e.g. calculus, statistics, etc.)
_____ Educational Uses of Computers (e.g. computer literacy)
_____ Computer Languages (e.g. BASIC, Fortran, etc.)
_____ Teaching Methods (other than mathematics specifically)

How many weeks of practicum (student teaching) were included? _____

If you have taken post-graduate courses (e.g. diploma or master's level), how many "courses" in each of the following areas?

_____ Mathematics Content (e.g. calculus, statistics, etc.)
_____ Mathematics Education (e.g. the teaching of mathematics)
_____ Computer Languages
_____ Computer Applications in Education

4. Continuing Professional Education

What professional associations do you belong to?

[] National Council of Teachers of Mathematics (NCTM)
[] Mathematics Council of the ATA (MCATA)
[] ATA Computer Council (ATACC)
[] Other ATA specialist council (specify) _____
[] Other (specify)_____

In the table below please indicate how many continuing professional education (in-service) activities in mathematics you have attended during the past three school years. We are interested in the numbers of "sessions" (about a half day each), and "workshops" (about a full day each), and "courses" (longer than a full day). In the last column, please list the general topic(s) covered (e.g. problem solving, diagnostic testing, using manipulatives, using computers).

Year	Sessions (half day)	Workshops (all day)	Courses (longer)	Topic(s)
1984-85				
1983-84				
1982-83				

5. Support for Mathematics Teaching

Please give your opinions about the adequacy of the following materials and services that support your teaching of mathematics by checking "More than adequate," "Adequate," or "Inadequate." We welcome your comments, as well. If you think of other materials, services, or professional development opportunities that are needed, please list them, too.

	More than Adequate	Adequate	Inadequate	Comments
Availability of Alberta Curriculum Guides				
Helpfulness of Alberta Curriculum Guides				
Availability of Prescribed Texts				
Quality of Prescribed Texts				
Availability of Supplemental Texts/Workbooks for Students				
Availability of Teacher Guides and Idea-books				
Availability of Manipulative Materials				
Availability of Diagnostic Tests				
Availability of Referral Services				
Help and Advice from Consultants				
Inservice About Teaching Particular Mathematics Topics				
Availability of Mathematics Periodicals (e.g. Arithmetic Teacher, delta-K)				
Availability of Calculators for Student Use				

	More than Adequate	Adequate	Inadequate	Comments
Availability of Computer Hardware				
Word Processing Software				
Data Base Management Software				
CAI Software for Students				
CAI Authoring Language (for Teachers)				
Mark-book Software				
Logo Language Software				
Student Programming Activities in BASIC				
Student Programming Activities in Logo				
Inservice About Using Computers in Mathematics				
Other (specify)				

Survey of Alberta Mathematics Teachers

Information from Secondary Teachers

1. Personal Information

Sex: [] Female [] Male

Age: [] Under 30 [] 30 - 40 [] 40 - 50 [] Over 50

Number of Years of Teaching Experience ____

2. Current Teaching Responsibilities

[] Full-time teacher [] Part-time teacher
[] Principal [] Asst. or Vice Principal
[] Mathematics Dept. Head [] Other Dept. Head

How many classes are you teaching this year (both semesters) at each of the following levels?

____Elementary Mathematics
____Grade 7 Mathematics
____Grade 8 Mathematics
____Grade 9 Mathematics

____Mathematics 10
____Mathematics 20
____Mathematics 30
____Mathematics 31

____Mathematics 13
____Mathematics 23
____Mathematics 33

____Mathematics 15
____Mathematics 25

____Other Secondary Mathematics
(Specify)_____

____Computer courses or options (Please give details.)
_____
_____

What percent (approximately) of your total teaching time is represented in the listing above? ____%

3. Pre-service Education

Which of the following degrees do you hold?

[] B. A. [] B. Sc. [] B. Ed. (3- or 4-year) [] B. Ed. (after)

[] Other Bachelor (specify) _____ [] Dip. Ed.

[] M. Ed. [] M. A. [] M. Sc. [] Other (specify) _____

In your preparation for teaching how many university "courses" did you take in each of the following subject areas? (By "course" we mean a one-semester course for three hours a week. This is called a "3-credit course" at the University of Alberta and a "half course" at the University of Calgary.)

_____ Calculus
_____ Statistics
_____ Other Pure Mathematics
_____ Mathematics Teaching Methods
_____ Educational Uses of Computers (e.g. computer literacy)
_____ Linear Algebra
_____ Computer Language(s)
_____ Other Applied Mathematics

How many weeks of practicum (student teaching) were included? _____

If you have taken post-graduate courses (e.g. diploma or master's level), how many "courses" in each of the following areas?

_____ Mathematics Content (e.g. calculus, statistics, etc.)
_____ Mathematics Education (e.g. the teaching of mathematics)
_____ Computer Language(s)
_____ Computer Applications in Education

4. Continuing Professional Education

What professional associations do you belong to?

[] National Council of Teachers of Mathematics (NCTM)
[] Mathematics Council of the ATA (MCATA)
[] ATA Computer Council (ATACC)
[] Other ATA specialist council (specify) _____
[] Other (specify) _____

In the table below please indicate how many continuing professional education (in-service) activities in mathematics you have attended during the past three school years. We are interested in the numbers of "sessions" (about a half day each), and "workshops" (about a full day each), and "courses" (longer than a full day). In the last column, please list the general topic(s) covered (e.g. problem solving, diagnostic testing, using manipulatives, using computers).

Year	Sessions (half day)	Workshops (all day)	Courses (longer)	Topic(s)
1984-85				
1983-84				
1982-83				

5. Support for Mathematics Teaching

Please give your opinions about the adequacy of the following materials and services that support your teaching of mathematics by checking "More than adequate," "Adequate," or "Inadequate." We welcome your comments, as well. If you think of other materials, services, or professional development opportunities that are needed, please list them, too.

	More than Adequate	Adequate	Inadequate	Comments
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Helpfulness of Alberta Curriculum Guides				
Availability of Prescribed Texts				
Quality of Prescribed Texts				
Availability of Supplemental Texts/Workbooks for Students				
Availability of Teacher Guides and Idea-books				
Availability of Manipulative Materials				
Availability of Diagnostic Tests				
Availability of Referral Services				
Help and Advice from Consultants				
Inservice About Teaching Particular Mathematics Topics				
Availability of Mathematics Periodicals (e.g. Mathematics Teacher, delta-K)				
Availability of Calculators for Student Use				
Availability of Computer Hardware				

	More than Adequate	Adequate	Inadequate	Comments
Word Processing Software				
Data Base Management Software				
CAI Software for Students				
CAI Authoring Language (for Teachers)				
Demonstration Software (e.g. Graphing Utilities)				
Mark-book Software				
Logo Language Software				
Student Programming Activities in BASIC				
Student Programming Activities in Logo				
Inservice About Using Computers in Mathematics				
Other (specify)				

In which of the following areas do you think there is a need to improve the mathematics teaching in your school? (Check any that apply.)

[] More or better print materials for students
[] More or better manipulative materials for students
[] More or better computer materials for students
[] More or better professional materials for teachers
[] More in-service opportunities for teachers
If so, on what topic(s)?

[] Other needs (specify)

[] None of the above